



## **FACULTY OF SCIENCE**

### **DEPARTMENT OF BOTANY AND PLANT BIOTECHNOLOGY**

**MODULE        BOT2A10 PLANT ANATOMY AND CYTOLOGY**

**CAMPUS        APK**

**EXAM            JULY 2015**

**DATE:            02 JULY 2015**

**SESSION: 11:30 – 13:30**

**ASSESSOR:**

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**INTERNAL MODERATOR:**

**PROF PM TILNEY**

**DURATION: 2 HOURS**

**MARKS: 100**

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**NUMBER OF PAGES: 9 PAGES**

**INSTRUCTIONS: ANSWER ALL THE QUESTIONS.**

**REQUIREMENTS: EXAM BOOK**

## BOT2A10 - PLANT ANATOMY AND CYTOLOGY SUPPLEMENTARY

### QUESTION 1

Study the micrograph of a plant structure (Fig. A).

- 1.1 What type of microscope was used to take this image? Write your answer in full. (1)
  - 1.2 Mention *one* significant advantage of using this type of microscope and *one* disadvantage. (2)
  - 1.3 Name this plant structure. (1)
  - 1.4 Is this structure haploid or diploid? (2)
  - 1.5 Name the substance which is a major component of the tough outer coat of this structure. (2)
  - 1.6 What is the magnification of this micrograph? (2)
- [10]**

### QUESTION 2

Study the micrograph of a cell (Fig. B)

- 2.1 By referring to one specific structure in the micrograph, explain whether this is a plant or an animal cell. (2)
  - 2.2 What type of microscope was used to take this image? Write your answer in full. (1)
  - 2.3 Identify each of the following letters as specifically as possible: **a, b, c, d, e, f, g, h, i.** (9)
  - 2.4 Give *one* main function of (2)
    - 2.4.1 **c**
    - 2.4.2 **e**
  - 2.5 Mention two significant differences in structure and/or chemical composition between **a** and **i.** (2)
  - 2.6 Is this cell meristematic? Motivate your answer. (3)
- [19]**

### QUESTION 3

Study the micro photo (Figure C) of a portion of a cell with a complete plastid and then answer the following questions relating to it.

- 3.1 What type of microscope was used to take this image? Write your answer in full. (1)

### QUESTION 3 (CONTINUING)

- 3.2 Mention *one* significant advantage of using this type of microscope and *one* disadvantage. (2)
- 3.3 This plastid is in the process of changing from one type to another.
- 3.3.1 What are these two types? Explain your answer by referring to a characteristic feature of each of these plastids visible in the micro photo. (4)
- 3.3.2 Give an example of an event in the life of a plant when this process would take place. (2)
- 3.4 This micrograph is magnified 32 000 times (x 32 000). What is the approximate length of this plastid? Show your working. (4)
- 3.5 Name two structures (not necessarily visible in this micro photo) which are characteristic of *all* plastids. (2)

[15]

### QUESTION 4

Study the diagram of a transverse section through the leaf of a grass (Figure D).

- 4.1 Is this a C3 or C4 plant? Explain your answer by referring to two anatomical structures. (3)
- 4.2 Draw sufficient of the diagram (no details of cells required) to show the following: bundle sheath extension, bulliform cells, xylem, phloem, epidermis. Label these structures (4)
- 4.3 Label the adaxial and abaxial sides of the leaf. Motivate your answer. (4)

[11]

### QUESTION 5

Study the micro photo of a portion of wood (Figure E).

- 5.1 What type of section is it? (1)
- 5.2 Is the plant a gymnosperm, monocotyledon or dicotyledon? Motivate your answer. (2)
- 5.3 Draw a diagram of it and label it fully. (4)
- 5.4 Mention the main function of each of three major types of cells shown on the micro photo. (3)

[10]

## QUESTION 6

Study the diagram which represents a portion of a transverse (cross) section through a stem (Figure F)

6.1 Write down *only the number* which represents each of the following parts: (5)

6.1.1 The vascular cambium

6.1.2 The first-formed growth ring

6.1.3 Primary xylem

6.1.4 Dilated ray in the secondary phloem

6.1.5 Phellem

6.2 What is the approximate width of the growth ring 19 (in radial direction)? (3)

6.3 What is the age of this stem in completed years? Motivate your answer. (2)

**[10]**

## QUESTION 7

7.1 Name two organelles that are **usually** found in plant cells but are absent in mature sieve tube elements. (2)

7.2 Mention two significant differences in the structure of the female gametophyte between gymnosperms and angiosperms. (2)

7.3 What is double fertilization and what are the results of this process? (4)

7.4 In which plant groups is double fertilization present? (1)

**[9]**

## QUESTION 8

Refer to the diagrams (Figure G and H) in order to answer the following:

8.1 Diagrams (Figure G a – d) represent various seeds. For each of these diagrams, write down the number of the label line pointing to

8.1.1 the cotyledon(s)

8.1.2 the endosperm, if present (8)

8.2 Study diagram (Figure H). What type of germination is shown? Explain your answer. (2)

**[10]**

### QUESTION 9

Give the correct term for each of the following:

- |   |            |
|---|------------|
| 9.1. A cell that originates jointly with a sieve tube member from the same mother cell.                     | (1)        |
| 9.2. A vertically-elongated cell that forms part of the vascular cambium.                                   | (1)        |
| 9.3. A meristem that gives rise to the root cap.  | (1)        |
| 9.4. A connection in a cell wall where protoplasm of one cell is in contact with that of the adjacent cell. | (1)        |
| 9.5. The characteristic end wall of vessel elements.  | (1)        |
| 9.6. The diploid generation in the life cycle of plants.  | (1)        |
|   | <b>[6]</b> |

<b>TOTAL</b>	<b>100</b>
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Figure A

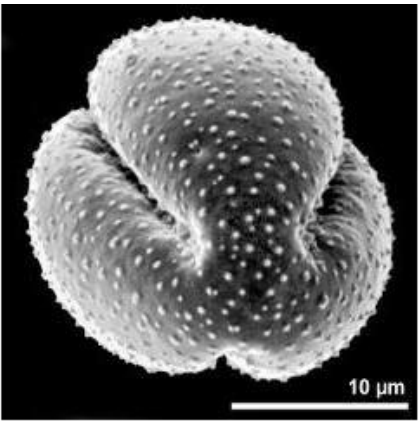


Figure B

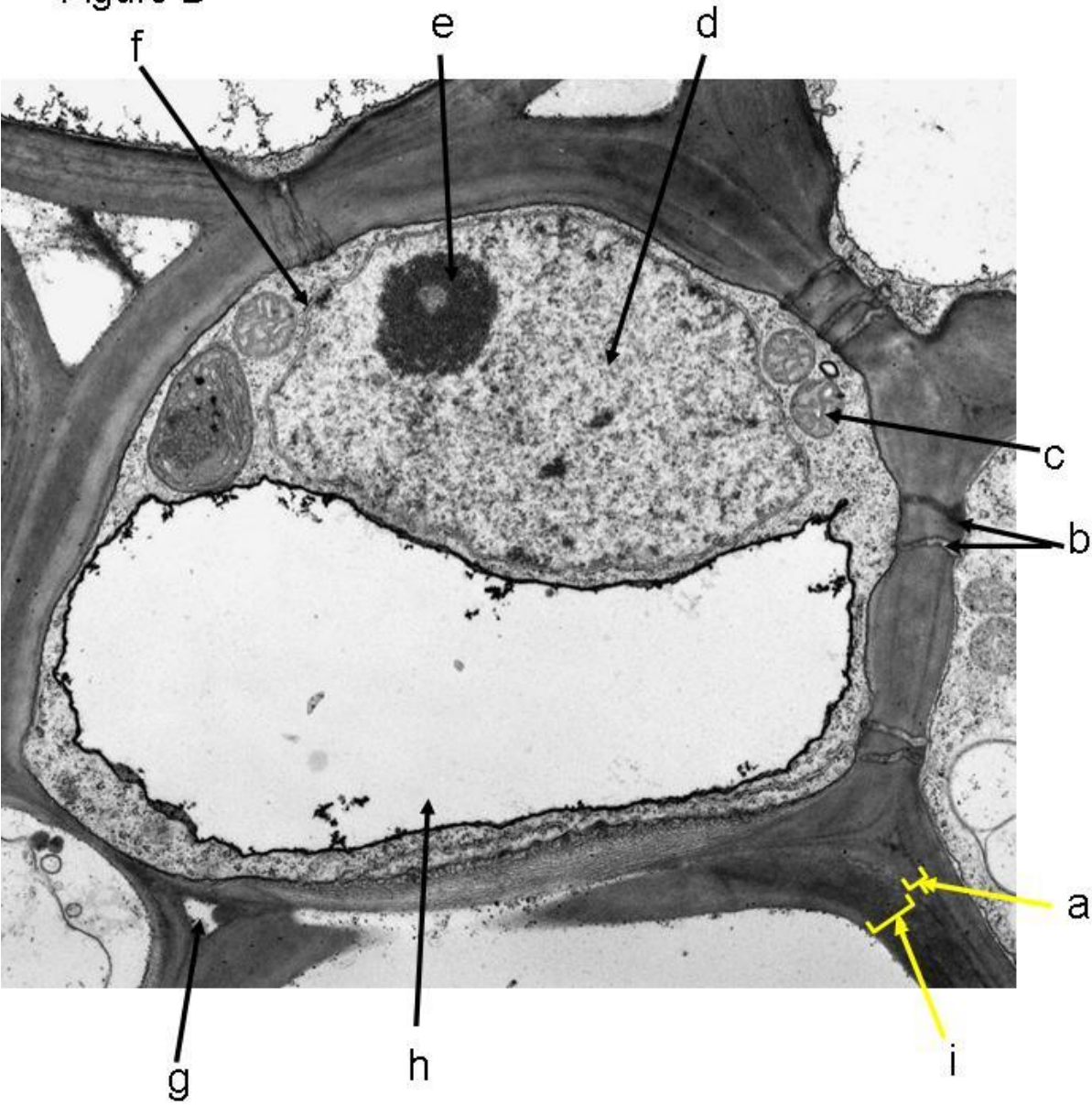


Figure C

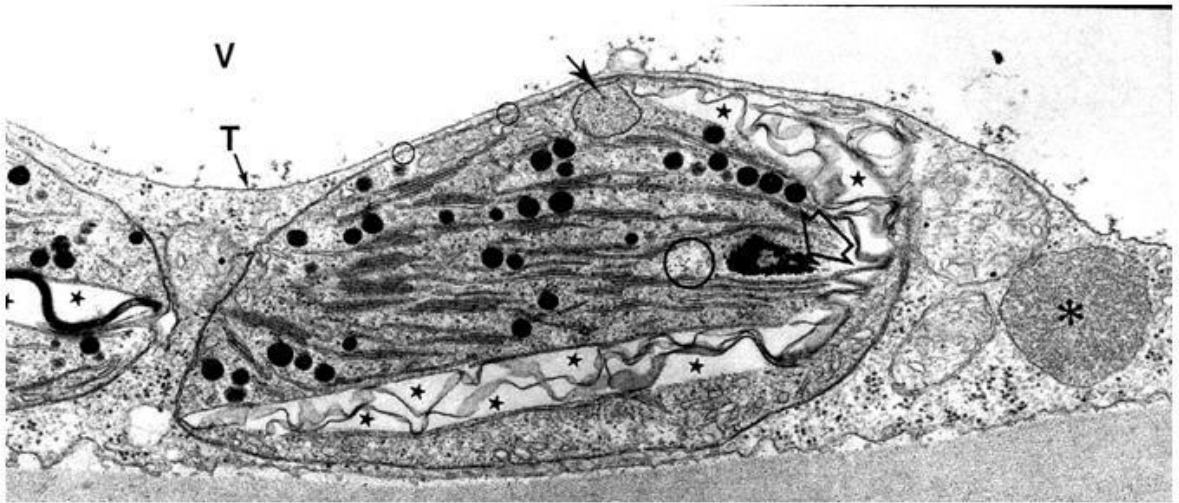


Figure D



Figure E





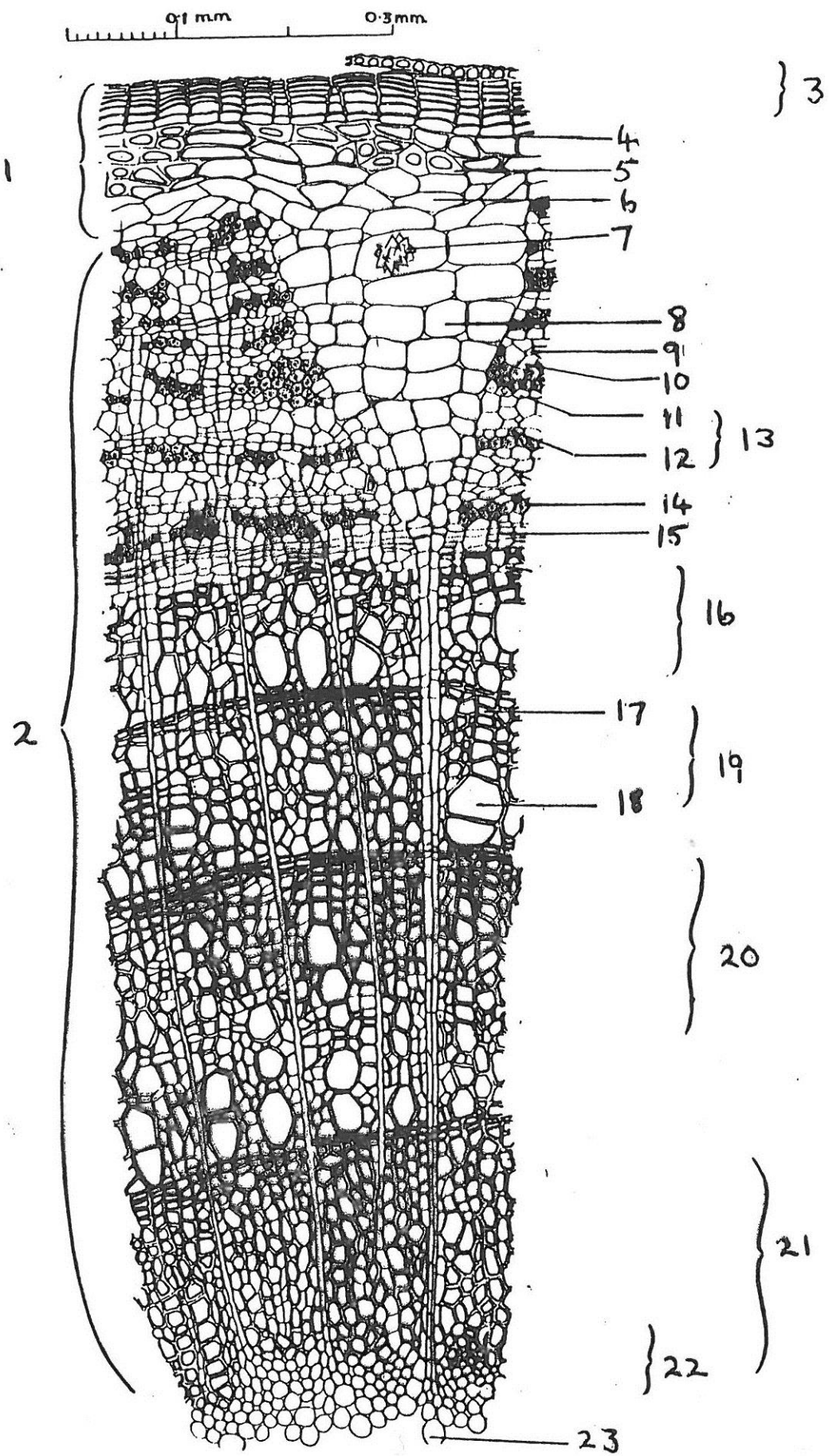




Figure G

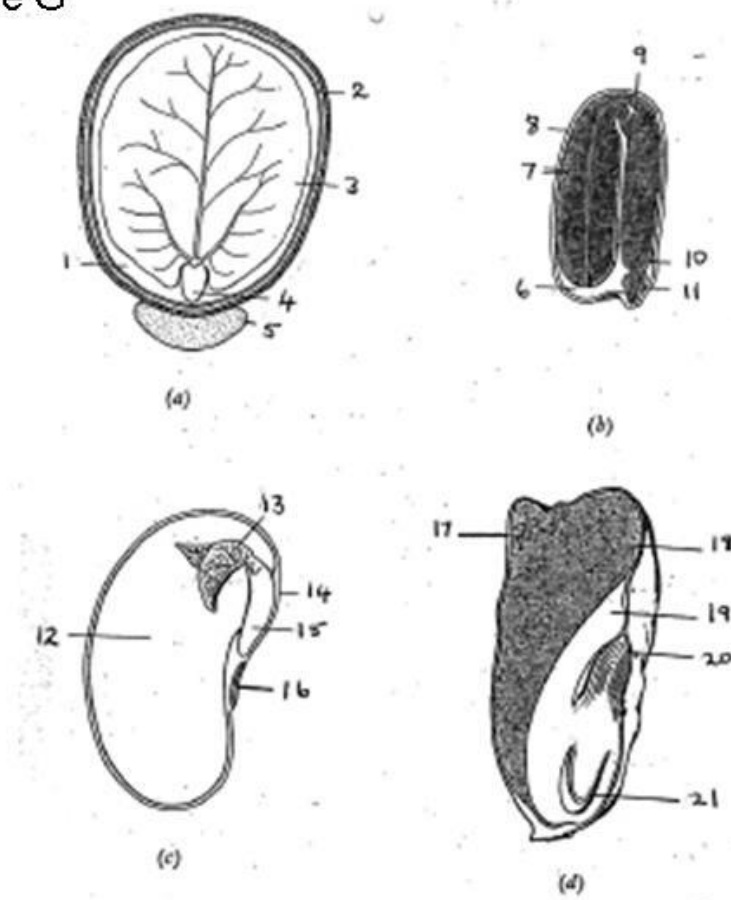
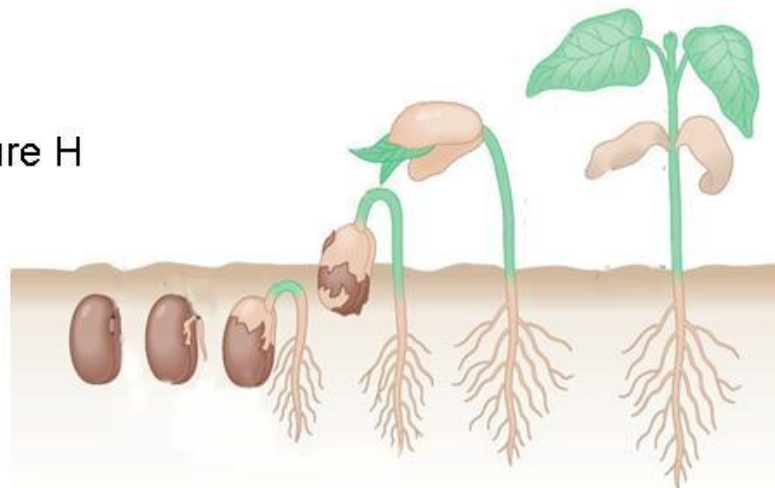


Figure H



Total: 100

## MEMORANDUM

### QUESTION 1

Study the micrograph of a plant structure (Fig. A)

- 1.1. Scanning electron microscope (1)
- 1.2. One of the advantages (large samples, showing 3D-structure); low resolution as an disadvantage (2)
- 1.3. Pollen grain (1)
- 1.4. Haploid (2)
- 1.5. Sporopollenin (2)
- 1.6. Magnification = length of scale bar (24 mm= 24000  $\mu\text{m}$ )/scale bar value (10  $\mu\text{m}$ ) = 2400. (2)

[9]

### QUESTION 2

Study the micrograph of a cell (Fig. B)

- 2.1. Plant cell (1). Cell wall (1): (2)
- 2.2. Transmission electron microscope (1)
- 2.3.
  - a – primary cell wall (1)
  - b – plasmodesmata (1)
  - c – mitochondrion (1)
  - d – nucleus (euchromatin) (1)
  - e – nucleolus (1)
  - f – nuclear envelope (1)
  - g – intercellular space (1)
  - h – central vacuole (1)
  - i – secondary cell wall (1) (9)
- 2.4. Give *one* main function of (2)
  - 2.4.1 c – producing energy (synthesis of ATP) (1)
  - 2.4.2 e – synthesis of ribosomal RNA (assembly of ribosomes) (1)
- 2.5. Irregular arrangement of cellulose microfibrils, lack of lignin or suberin in the primary cell wall (a) *vs* regular pattern of cellulose microfibrils and the presencs of lignin or suberin in the secondary cell wall (i) (2)
- 2.6. No. Unlike meristematic cells, this cell has large central vacuole and secondary cell wall(3)

[19]

### QUESTION 3

Study microphoto (Figure C) of a portion of a cell with a complete plastid and then answer the following questions relating to it.

3.1 Transmission electron microscope (1)

3.2. Advantage: high resolution. Disadvantages: only dead specimens can be studied, time-consuming preparation of samples (2)

3.3.1 Chromoplast (undulating membrane, plasmoglobuli), and chloroplast (grana) (4)

3.3.2 E.g. during ripening of fruits (2)

3.4 E.g. magnification ( $\times 32\,000$ ) = plastid length in micrograph divided by actual length of chloroplast. Length of chloroplast in micrograph = ca. 11  $\mu\text{m}$  (110 000  $\mu\text{m}$ ). Therefore, actual length of chloroplast is 110 000 divided by 32 000 = **3-4  $\mu\text{m}$**  (4)

3.5. E.g. double membrane, small ribosomes, circular DNA (2)

[15]

#### QUESTION 4

4.1 C4. Two types of mesophyll cells (bundle sheath cells and ordinary mesophyll cells), Kranz anatomy (conspicuous bundle sheaths and mesophyll cells forming a wreath-like structure) (3)

4.2 Bundle sheath extension, bulliform cells, xylem, phloem and epidermis are correctly labeled. (4)

4.3 Adaxial (upper) side and abaxial (lower) side of the leaf are correctly labeled. Adaxial side of leaf can be recognized by the presence of bulliform cells or by the position of xylem in conductive bundle. (4)

[11]

#### QUESTION 5

5.1 Tangential section (1)

5.2 Dicotyledon. Presence of vessels in wood. Monocotyledons do not form wood. (2)

5.3. Vessels, rays, (libriform) fibers are correctly labeled (4)

5.4. Vessels – water conduction, libriform fibers – support, ray parenchyma - storage (3)

[10]

#### QUESTION 6

6.1.1 - 15 (1)

6.1.2 - 21 (1)

6.1.3 - 22 (1)

6.1.4 - 8 (1)

6.1.5 - 3 (1)

6.2. 0,2 mm (3)

6.3. Three years (= number of the growth ring boundaries). (2)

## QUESTION 7

7.1 Nucleus, vacuole, also ribosomes, dictyosomes (2)

7.2. Female gametophyte of gymnosperms consists of few thousands cell and has archegonia, whereas female gametophyte of angiosperms (embryo sac) made of few cells, and it has no archegonia. (2)

7.3. Double fertilization is the fusion of egg and sperm (resulting in a diploid fertilized egg, the zygote, that gives rise to the embryo) and the fusion of the second sperm with two polar nuclei of central cell of the embryo sac (resulting in a triploid nucleus that gives rise to endosperm) (4)

7.4. In angiosperms, also in gymnosperms *Gnetum* and *Ephedra* (1)  
[9]

## QUESTION 8

8.1. Diagrams (a) – (d) represent various seeds. For each of these diagrams, write down the number of the label line pointing to

8.1.1 - **3, 7, 12, 19**

8.1.2 – **1, -, -, 18.** (8)

8.2 Epigeal; cotyledons are lifted above ground (2)  
[10]

## QUESTION 9

9.1. Companion cell (1)

9.2. Fusiform initial (1)

9.3. Calyptragen (1)

9.4. Plasmodesma (1)

9.5. Perforation plate (1)

9.6. Sporophyte (1)  
[6]